Volume 21 August, 1935 Number 8

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Air-Conditioning Equipment

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published by

The Texas Company, 135 East 42nd Street, New York City

Vol. XXI | August, 1935 | No. 8

Change of Address: In reporting change of address kindly give both old and new addresses.

Lubrication of Air-Conditioning Equipment

STUDY of the lubrication of refrigeration machinery as applied to air-conditioning operations has been actively extended over recent years with the markedly increased popularity of comfort cooling. It has been particularly accelerated by the necessity for lubricating oils employed in compressor service to function dependably over extended periods of time, and under a wide variety of operating conditions. The function of the compressor is especially important, as it must recover the refrigerant or cooling agent after the latter has been evaporated in the cooling side of the system, and then bring it into such a form as to render it again capable of cooling. This cycle must be continuous and positive.

Advances in the study of compressor design, in turn, have led to the adoption of two distinct types of compressors, viz.:

(1) The reciprocating machine, either single or double acting, of one or more cylinders, according to the size of the job and the amount of refrigeration required, and

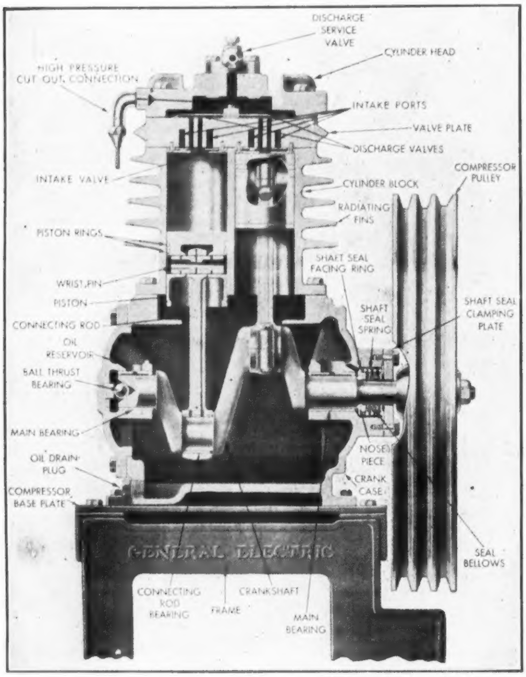
(2) the centrifugal compressor. This latter is unique by reason of the constant pressures available, and the comparative simplicity of its lubricating system.

In part, this trend in design has been due to the higher loads which must be carried, space limitations, and the physical properties of a group of refrigerating chemicals which have proved especially adaptable to air-conditioning service. Compressor operations under these conditions impose a definite load upon the lubricant which must be fully anticipated before any such machine is put into service. Otherwise difficulty may result, especially if the oil is not suited to the operating requirements, or to the physico-chemical nature of the refrigerant. To fully realize the importance of lubrication and its bearing on efficient compressor operation the mechanics of the compression process and the details of compressor design must be thoroughly understood.

An air-conditioning compression system will include a compressor, an oil trap, condenser, expansion valve and evaporating element. In air-conditioning operation as already stated the compressor may be of either the centrifugal or reciprocating type. Where the latter is involved the principles of single or double acting operation will prevail. In the compression process the refrigerant or cooling agent is recovered after each expansion by means of mechanical compression. To bring this about the compressor performs three functions in that it serves first as a pump to withdraw gas from the cooling unit through the suction line, and then to compress this gas to a comparatively high pressure prior to discharge into the condenser. At this point the discharge control serves to divide the low and high pressure sides of the system and maintain maximum efficiency of operation by preventing leakage

of the compressed vapor back into the low pressure side.

In the process of refrigeration the gaseous refrigerant which has left the compressor must be cooled to convert it to liquid form. Under compression alone it will still remain as a gas due to the fact that the application of pressure raised the temperature above the liquefaction point.



Courtesy of General Electric Company

Fig. 1—Sectional view of the General Electric CM Compressor, showing details of construction. Note in particular bearing design and relative location of lubrication elements.

From the discharge end of the machine the gas is therefore passed to the cooling coils of the condenser where the temperature is lowered by means of air in some smaller types of air-conditioning units, or by cold circulating water in larger installations, to convert this gas into liquid form. It is then capable of serving as a cooling medium. This is brought about by passing it through an expansion or regulating valve on the expansion side of the system. Here, by virtue of a drop in pressure, it evaporates and returns to its gaseous state. In so doing it gives up its latent heat of vaporization and as a result is capable of absorbing heat. After suitable circulation through the heat transfer element and air-conditioning unit the refrigerant is then ready for return to the compressor for repetition of this cycle.

TYPES OF INSTALLATIONS

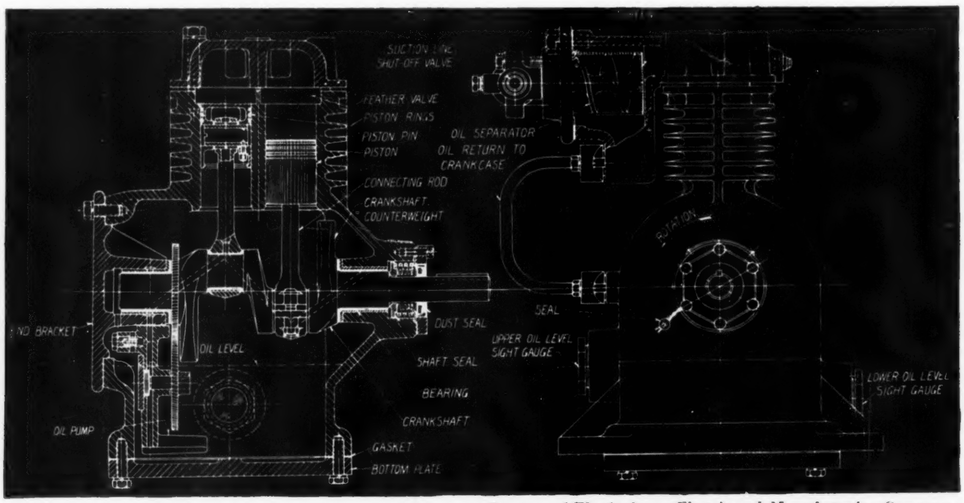
Air-conditioning installations as they are being planned today may be broadly divided into two classifications, viz.:

The Centralized, and

The Unit Type.

Centralized installations are normally designed to serve an extensive amount of space such as would be involved in theatres, restaurants, clubs, hospitals, office buildings and public halls. From one to an extensive number of rooms can be conditioned by such a system, dependent upon the feasibility of installing the necessary ducts for air circulation. The compactness of the compressor and other machinery renders location a very flexible matter, from a corner of the power-plant or basement to any available space regardless of floor level.

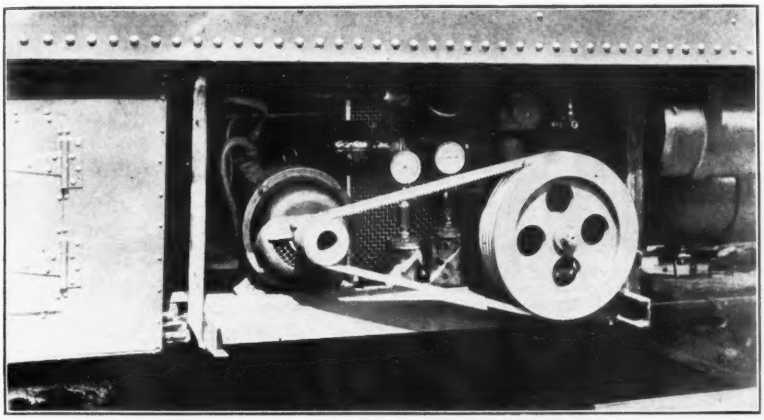
Unit air-conditioning, in turn, is generally



Courtesy of Westinghouse Electric and Manufacturing Company

Fig. 2—Detailed view of a Westinghouse compressor designed for air conditioning service, showing oil level in the crankcase and means of circulation. Note in particular the location of the oil separator and oil return to the crankcase.

applicable to homes, individual office rooms, dining cars and other railway equipment. Normally a unit installation involves a complete compressor and refrigerating system for each room or compartment to be served.



Courtesy of York Ice Machinery Corporation

Fig. 3—The York railroad type Freon compressor and motor with V-belt drive and special mounting for installation under a passenger car.

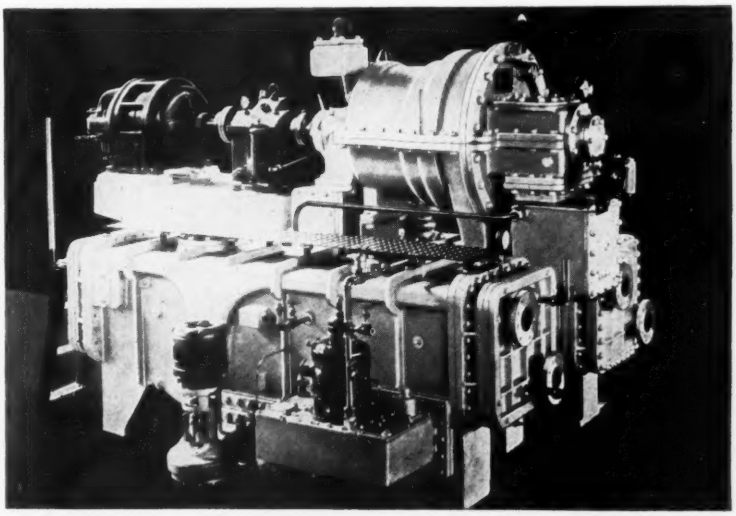
The centrifugal type of compressor has been widely adapted to central station applications along with the more conventional type of multi-cylinder reciprocating machine.

MISCIBILITY WITH LUBRICATING OILS

Certain refrigerants are completely miscible with petroleum lubricating oils. In air-conditioning service we are particularly concerned with freon, carrene and methyl chloride, although there are a considerable number of other refrigerants of chlorinated hydro-carbon nature, or the halo-fluoro derivatives of aliphatic hydro-carbons which must also be considered.

The extent to which the compressor oil in an air-conditioning system may come into appreciable contact with the refrigerant will depend upon the type of compressor. The centrifugal machine presents a comparatively simple problem involving the lubrication of ring-oiled bearings and the maintenance of a seal against loss of vacuum. Normally, a certain amount of leakage of the refrigerant, which is generally carrene (dichloromethane), will occur; it will not be sufficiently extensive, however, to give any concern as to the resultant lubricating ability of an oil which has been specifically refined for this class of service.

In the reciprocating installation the question of the method of lubrication enters into the problem. Small tonnage units designed for splash lubrication, as are so many of the vertical unit type railway or household machines, depend upon oil thrown from the crank to splash the necessary amount of oil to the cylinders and bearings. Where there is possibility of some of this oil passing over to the high pressure side to become mixed with the refrigerant, there is provision for return directly to the crankcase. In such machines an oil level regulating device is therefore frequently installed, although if care is observed not to charge the compressor with too much oil to begin with, oil level regulation may not be necessary; it is therefore not always used on the small unit type of machine. In other designs oil is returned to the condensing unit by the velocity of the refrigerant vapor.

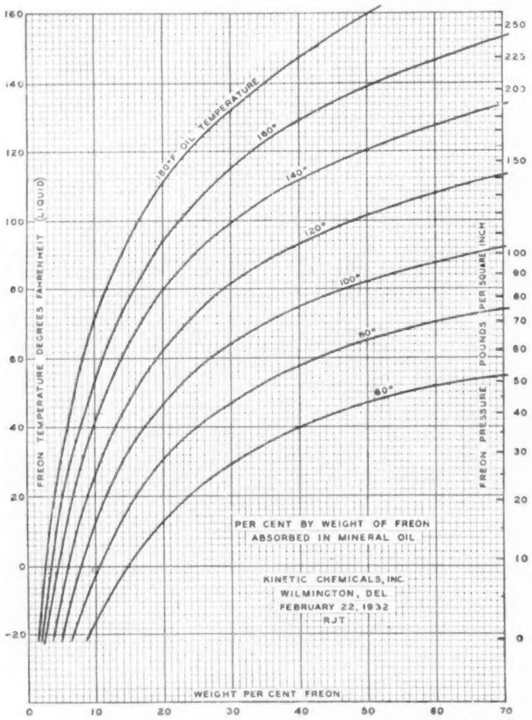


Courtesy of Carrier Engineering Corporation

Fig. 4—Showing a typical Carrier centrifugal type refrigerating compressor as adapted to central station air conditioning operations.

The reciprocating compressor can also be built so that the refrigerant vapors are kept

entirely apart from the crankcase. In such machines the possibility of mixture with oil at least at this point is largely eliminated. This enables the oil to maintain its original viscosity, or merely to follow the normal reduction in viscosity which would take place as the crankcase comes up to average operating temperature. This condition will prevail in the enclosed crankcase machine equipped with trunk-type pistons and designed for pressure lubrication. The oil pump maintains positive circulation of oil without excessive splash effect, therefore, foaming is markedly decreased. Reduction of oil splash in turn reduces the tendency of any refrigerant present to mix with the oil supply, especially as there is no circulation of refrigerant vapors within the crankcase. Location of the oil pump in such a machine must of course be carefully studied. Some authorities recommend that it be at the lowest point in the case to insure against loss of suction and the resultant reduction in volume of oil circulated which might readily lead to impaired lubrication; others feel that a settling chamber below the pump is an advantage.



Courtesy of Kinetic Chemicals, Inc.

Fig. 5—Chart showing percent by weight of Freon absorbed in mineral oil for various temperatures and pressures.

The cross head type of vertical compressor as well as the horizontal double-seal stuffing box machine are also adaptable to large tonnage central station air-conditioning service. In these units the refrigerant vapors are also kept out of the base or crankcase of the machine; instead they are returned directly to the cylinder block. As a result there is no possibility of the oil in the case becoming mixed with refrigerant, so here again foaming, especially with freon, is eliminated along with reduction in viscosity. Since lubrication of the crankcase elements or external parts is maintained entirely independent from the cylinders, it is customary to provide for injection of a certain amount of oil into the refrigerant return line or directly to the cylinder and stuffing boxes to take care of piston and valve lubrication and protection of the cylinder walls against scoring.

Factors Governing Absorption of Freon By Lubricating Oil

Apart from mechanical and constructional conditions the amount of freon which may be absorbed by any mineral oil will be dependent upon the viscosity of the oil at the temperature of contact and the pour test of this oil; pressure also becomes a factor. In other words, larger amounts of freon are absorbed by mineral oils at higher pressures and lower temperatures, just as smaller amounts of this refrigerant will be absorbed at lower pressures and higher temperatures. In addition, lower viscosity oils absorb less freon for a given

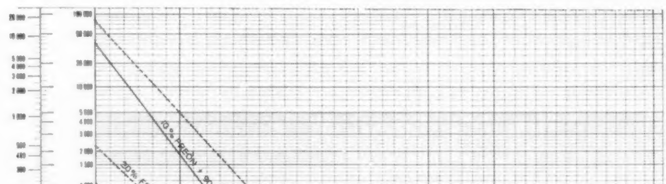
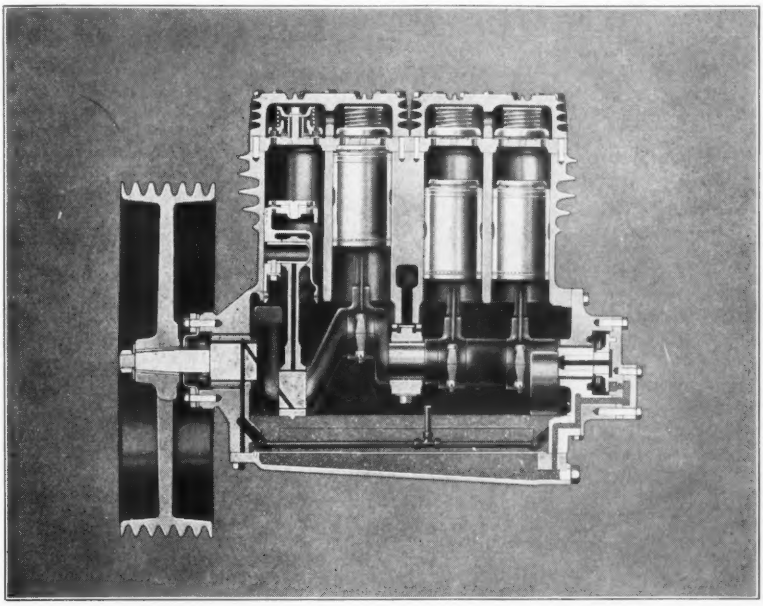


Fig. 6—Viscosity Temperature Chart showing viscosity curves for oils of 150 and 300 seconds, Saybolt Universal Viscosity, at 100 degrees Fahr., when diluted with 10, 20 and 30 percent of Freon.

weight than will lubricants of higher viscosity.



Courtesy of Frigidaire Corporation

Fig. 7—Showing a cut-away view of the Frigidaire 4 cylinder air conditioning compressor. All parts of this machine are designed for very accurate precision and lubrication is entirely automatic.

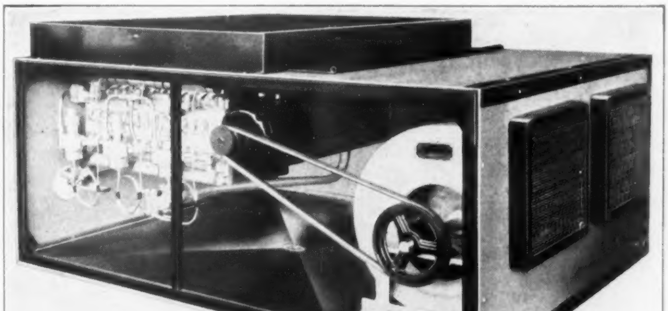
LUBRICATING OIL REQUIREMENTS

Viscosity Range

This matter of mixture of petroleum lubricating oils with refrigerants of halogen combinations must of course influence the original selection of such lubricants from the viewpoint of viscosity. In other words when dealing with lubrication of a compressor charged with freon or methyl chloride an oil of somewhat higher original viscosity must be used than would be necessary were the refrigerant to be nonmiscible with such an oil. Theoretically a wide range of operating and constructional conditions exist which should be given careful consideration. Unfortunately, however, these may occur in such a variety of combinations as to render it necessary to adopt a broad grouping of oil characteristics contingent upon the most influential factors such as speed, intake and discharge temperatures, means of cooling and the method of application of the oil.

For example: in a small capacity enclosed type slow-speed machine operating from an evaporator temperature around zero degrees Fahrenheit, an oil of from 150 to 300 Seconds Saybolt Viscosity at 100 degrees Fahrenheit, will be advisable, the higher viscosity range being approached in accordance with positive information as to the normal content of refrigerant. Some interesting test data have been developed to indicate that this will be from 10 to 12 percent in average service. To realize the extent to which this will reduce the viscosity of a 300 viscosity oil one should refer to the accompanying charts. In brief, using an oil of this viscosity in an enclosed reciprocating machine operating at 130 degrees Fahr., crankcase temperature and 40 pounds suction pressure, reference to Fig. 5 shows a normal Freon content of approximately 11 percent. Subsequent reference to Fig. 6 indicates that with such a Freon content the atmospheric viscosity of the mixture at 100 degrees Fahr., will be around 70 seconds Saybolt.

As one approaches higher speed, load or tonnage conditions, however, such as might prevail in the central station installation or on the relatively high speed railway compressor, an increase in viscosity is deemed advisable, with proportionately less stress being attached to the pour test of the oil due to the higher operating temperature range. In such installations the oil viscosity may have to range from 300 to 900 seconds Saybolt at 100 degrees Fahr., according to type and capacity of the compressor.

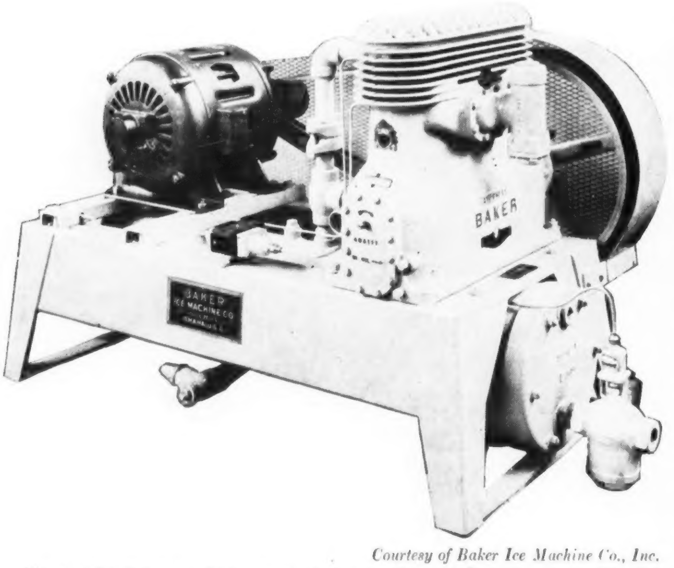


Courtesy of Kelvinator Corporation

Fig. 8—A Kelvinator air conditioning unit of the suspended type with side panel removed to show the interior.

Flash Point

While the average air-conditioning compressor will function at maximum tempera-



Courtesy of Baker Ice Machine Co., Inc.

Fig. 9—The Baker 4 cylinder, vertical, reciprocating, single acting air conditioning compressor. Timken roller bearings are used on both the drive and blind end. Crankshaft and connecting rod bearings, as well as piston pins are under full force feed lubrication which is maintained by a built-in, positive drive, high pressure gear type oil pump.

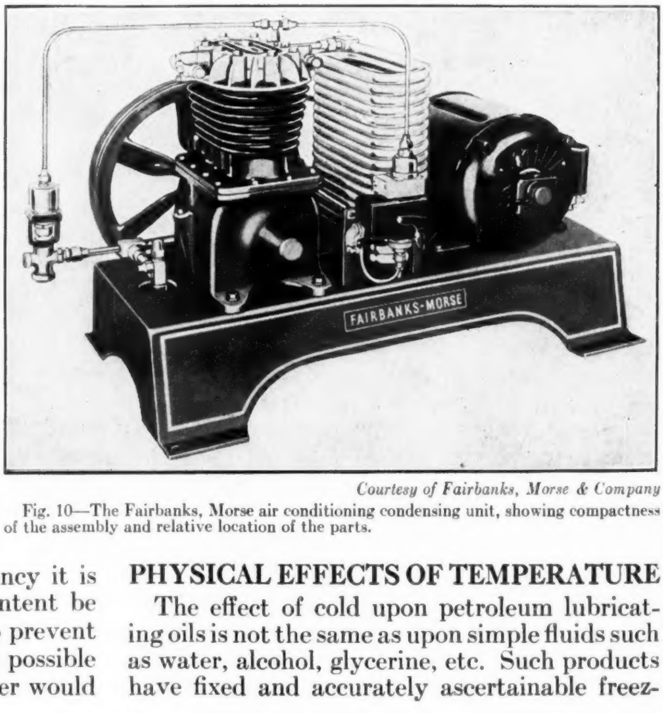
tures considerably below 200 degrees Fahr., there will be times when an installation of the booster type may approach 250 degrees Fahr., on the discharge side. For this reason the flash point as an indication of the relative vaporizing tendency of petroleum lubricating oil must be given consideration. Fortunately, the flash point of even the lower viscosity oils will be sufficiently above 350 degrees Fahr., to preclude any abnormal vaporization and thickening of the oil.

A further indication of the degree of refinements is the extremely low tendency to form carbon residue on heating, which will be shown by such oils.

Corrosion and Resistance to Breakdown

The tendency which any petroleum lubricating oil will have to bring about the above reactions will be more or less a measure of the method of refinement. In the interest of reducing the corrosion tendency it is especially essential that the water content be practically nil; this is also necessary to prevent freezing at the regulating valve and possible restriction of flow of refrigerant. Water would also freeze in the cooling coils, to reduce evaporative efficiency. A dehydrated oil is also advisable to prevent possible chemical dissociation of freon, which might lead to serious damage to the machine parts through acid formation.

The results which may accrue from chemical breakdown of the oil itself will be very disturbing in the average air-conditioning installation regardless of the type of refrigerant used, for it will lead to gum formation and actual stopping of the unit. Resistance to breakdown is determined by the petroleum chemist in terms of resistance to oxidation. A variety of interesting tests have been developed to enable accurate prediction of this tendency and to guide him in development of refinery methods which will effectively remove those hydro-carbon constituents which may be unstable and thereby most readily susceptible to chemical dissociation. It is this latter which is regarded as being the basic cause of gum formation, and deposition of residual matter around piston rings, or in bearing oil grooves. Its formation is materially accelerated by heat in the presence of moisture, or by the solvent action of certain chemicals.

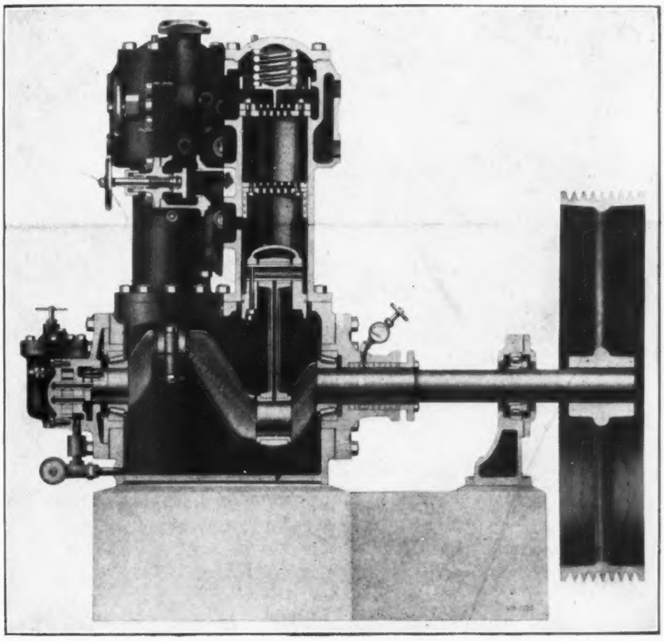


Courtesy of Fairbanks, Morse & Company

Fig. 10—The Fairbanks, Morse air conditioning condensing unit, showing compactness of the assembly and relative location of the parts.

PHYSICAL EFFECTS OF TEMPERATURE

The effect of cold upon petroleum lubricating oils is not the same as upon simple fluids such as water, alcohol, glycerine, etc. Such products have fixed and accurately ascertainable freez-



Courtesy of Carbondale Machine Corporation

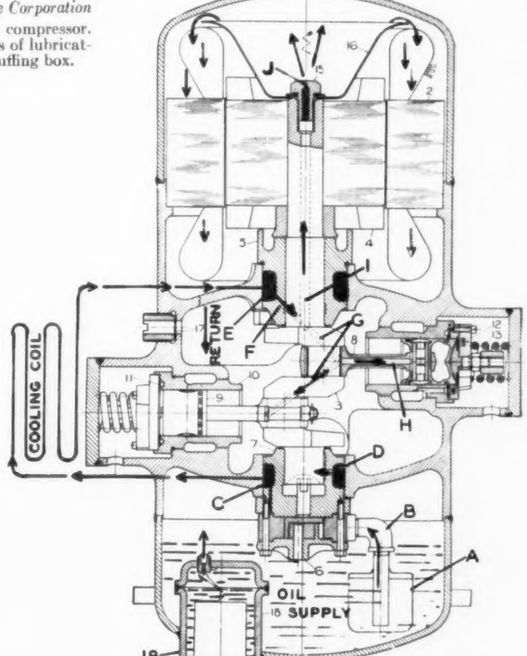
Fig. 11—Sectional view of a Carbondale vertical, two cylinder, Freon compressor. Note in particular use of the tapered roller bearing on the crankshaft, details of lubricating system for automatic and positive circulation of oil, and design of the stuffing box.

comparatively fluid at the lowest temperatures to which it may be subjected during operation. These temperatures will usually be encountered in the expansion or refrigerating side of the system after the refrigerant has passed the expansion valve. Should the refrigerant be carrying a high percentage of oil at this point, any tendency towards wax congealment might lead to faulty operation of this valve or insufficient heat transfer. The pour test is indicative of the extent to which this may be expected. In the terms of the American Society for Testing Materials—"the pour point of a petroleum oil is the lowest temperature at which the oil will pour or flow when it is chilled, without disturbance under definitely prescribed conditions."

ing points at which a complete change from the liquid to the solid phase takes place. Lubricating oils, however, which are complex mixtures of hydrocarbons of various melting points or freezing points, behave like solutions and frequently deposit some portion of their constituents before the whole mixture solidifies.

This fact must be thoroughly recognized when specifying and refining such oils for air conditioning compressor lubrication, in conjunction of course with the minimum operating temperatures to which any such oil may be subjected. Fortunately, in average air-conditioning service these temperatures will not be as low as in some types of refrigeration work. They will, however, be sufficiently extreme to render the pour test one of the principal characteristics to be investigated in a study of lubricating oils for such service.

The varied behavior of certain types of petroleum oils when subjected to low temperature conditions has led to exhaustive study of methods of test, to determine accurately when congealment begins and fluidity becomes retarded. Where we are concerned with lubrication of compressors applied to air-conditioning installations this knowledge becomes of considerable value in the initial selection of lubricating oils which will possess adequate fluidity to enable ready handling by the conventional types of oil-circulating systems, and maintain protective lubrication of the parts to be served. Obviously the oil must also remain



Courtesy of Baldwin-Southwark Corp., De La Vergne Refrigeration Division

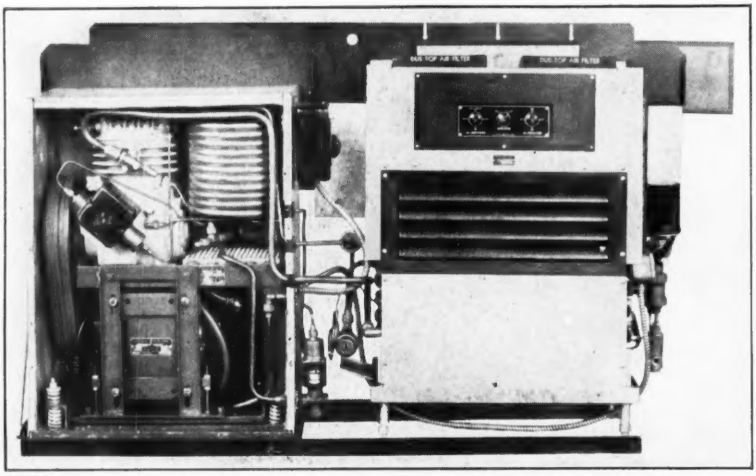
Fig. 12—A De La Vergne air conditioning unit. The oil pump, No. 6, takes oil from the oil supply by means of the strainer "A" through suction pipe "B" and discharges into chamber "C."

Part of the oil goes through hole "D" and lubricates the lower end of the crankshaft. From chamber "C" the oil passes through the cooling coil which is mounted outside and comes back to the compressor into chamber "E." From "E" the oil lubricates the shaft through hole "F" and lubricates the connecting rods by the drilled holes "G."

Wrist pin lubrication is taken care of by hole "H" in the connecting rod. The rest of the oil is passed through the shaft hole "I" and through nozzle "J" and splashed over the coils of the stator and from there falls by gravity through slots on the outside diameter of the stator into the lower part of the crankcase indicated as "oil supply" in the drawing.

The oil trap No. 18 is the means of discharging the oil which has collected in the system back into the compressor. Arrows indicate flow of oil.

The proviso in regard to disturbance is especially important. Extensive research has developed that any agitation or stirring of the oil while cooling in a pour test determination is contrary to good practice. When an oil is stirred it solidifies at a lower temperature than when held absolutely motionless. This is explained by the assumption that the movement of the oil destroys the formation of a fine network of microscopic particles of paraffinic bodies in the course of separation. This segregation is regarded as giving the oil a certain amount of support, to thereby facilitate solidification. The test procedure should therefore provide for absolutely motionless cooling.



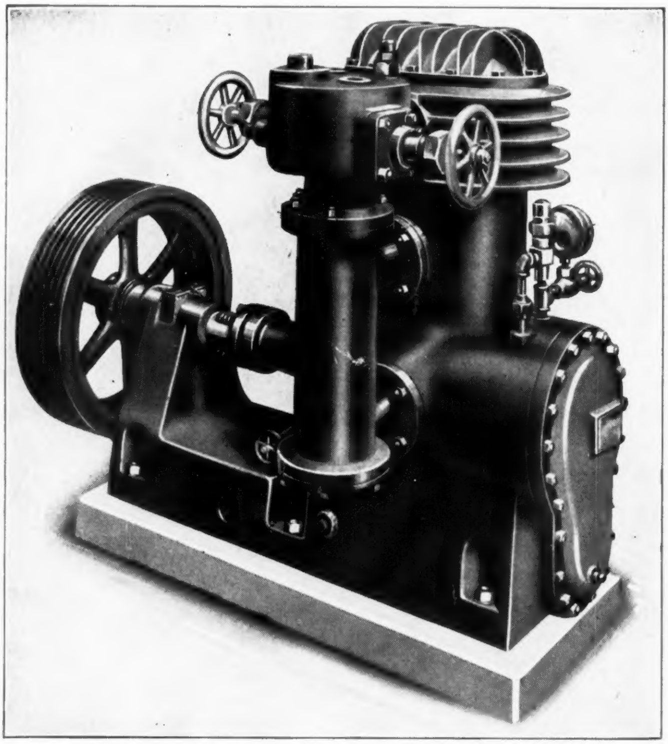
Courtesy of General Electric Company

Fig. 13—A G.E.-unit room air conditioner with cover removed to show relative location of the condensing unit and other parts.

Effect of Wax Content

Prior to the development of the several highly successful dewaxing processes which are now in general usage, pour test of a petroleum lubricating oil was deemed to be chiefly dependent upon the base of the oil and to some extent upon the viscosity. Today, however, the art of dewaxing has been so highly developed as to render pour test more definitely dependent upon the method of refinement, although the derivatives of naphthenic base crudes possess a naturally lower pour test and hence do not require such exacting treatment in the refinery process.

The sequence of operations is of distinct interest. The first step involves segregation of the lubricating fractions of the crude oil by distillation. Refrigerating oil stocks are normally distillates; these stocks are then subjected to chemical treatment and filtration. Oftentimes they are carried through a dewaxing process whereby the wax content is largely removed by crystallization and mechanical treatment, including further filtration, chilling or centrifuging. The wax content will normally be the controlling factor in regard to pour test or relative fluidity at low temperatures. All petroleum products contain a certain amount of wax. It is more pronounced, however, in crudes of paraffin base than those of naphthene base. Wax is also more difficult to remove from the former, as a result, unless a paraffin base stock has been especially de-

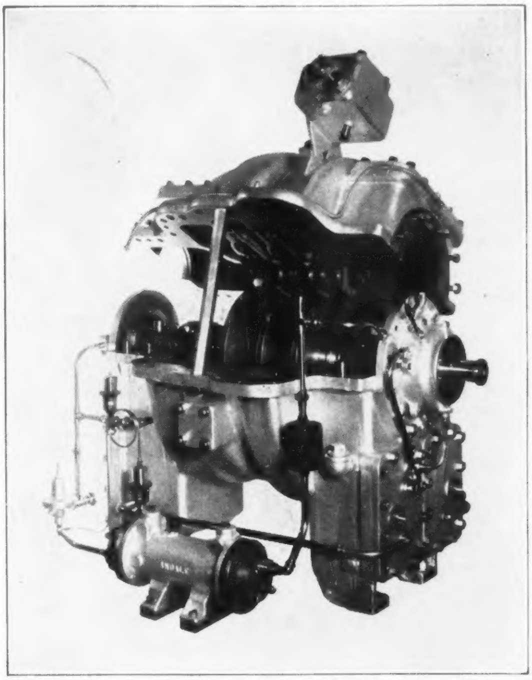


Courtesy of Frick Company

Fig. 14—Showing a Frick enclosed-type Freon compressor. A unique feature of this machine is the force feed oil pump which is located in the base of the crankcase and operated by a chain connection from the main shaft. This pump is located at the lowest point in the crankcase and the oil flows to same by gravity.

waxed it will show a considerably higher pour test than a naphthenic base oil of the same viscosity.

The dewaxed oil is finished or given final re-



Courtesy of Carrier Engineering Corporation

Fig. 15—Open view of a Carrier centrifugal refrigerating compressor, showing design of the interior, and essential piping.

finement by redistillation, chemical treatment, solvent extraction or filtration. Any of these processes may be used individually or in various combinations with one another. The ultimate objective, however, is the same in all cases, i.e., to increase the resistance to breakdown, lower the pour test and improve the chemical stability of the oil.

METHODS OF LUBRICATION

Splash, pressure or circulated lubrication by means of ring oilers, have proved the most adaptable methods of lubricating air-conditioning compressors. Splash oiling is best adapted to the small tonnage, enclosed-type, vertical reciprocating machine. Pressure lubrication in turn by means of an enclosed gear pump, an oscillating cylinder reciprocating pump, or, an external force feed lubricator is applicable to the larger type vertical or horizontal unit; whereas the ring oiler in conjunction with force feed, for sealing purposes has proved especially adaptable to the bearings of the centrifugal machine.

Splash Oiling Systems

In a splash system the oil is distributed at each revolution of the crank, the level in the crankcase being maintained just high enough to permit the crank to dip and splash the necessary amount of oil to the cylinder walls, etc. Continued operation will result in the crankcase being filled with a lubricating vapor above the main body of oil, which will also insure adequate lubrication of main, wrist pin and crank pin bearings.

When re-charging the case with oil the level must never be raised too high. Otherwise, oil would be churned by the crank, bringing about such violent agitation as oftentimes to preclude effective precipitation of any impurities that may have gained entry. There would also be possibility of loss of lubricant past the piston with subsequent entry of an excess of oil into the condensing and evaporating parts of the system, or increase in the rate of mixture with the refrigerant.

This can be partly overcome by proper adjustment of the piston rings. Where the latter are not sufficiently tight, if the crankcase contains too much oil or agitation is too violent, the excess which naturally will reach the cylinder walls will tend to work past the rings.

Courtesy of Kelvinator Corporation

Fig. 16—A Kelvinator self-contained unit with all panels removed to show interior details and relative location of the fan elements and the condensing unit.

This is not only wasteful, but a detriment, for if the oil is not of sufficiently low pour test there will be a possibility also of its congealing within the system, to act as an insulator and

reduce refrigeration to a marked degree. The presence of oil in the system may also cause a higher condenser pressure by reason of the vapor pressure produced by the oil.

Use of excess oil in a splash lubricated system will also involve the possibility of difficulty when draining and cleaning, especially where sludging has taken place. Churning of certain oils in a crankcase will give rise to sludge formation if they have not been very highly refined. In part, this is due to oxidation; it will be most probable where water is present or the oil is laden with foreign matter, such as dirt, metallic particles, or carbon.

It is, therefore, important to follow regular periods for cleaning, and to look carefully into the condition of the used oil, for this will very often indicate both the approximate suitability of the latter and the extent to which effective lubrication is being attained.

Pressure Lubrication

With a pressure system, more accurate control of the amount of oil delivered to cylinder walls and compressor bearings is made possible. On the other hand, some types of design may require more equipment, piping, etc., frequent filling of the reservoir where a mechanical force feed lubricator is installed, and regular attention from the operator.

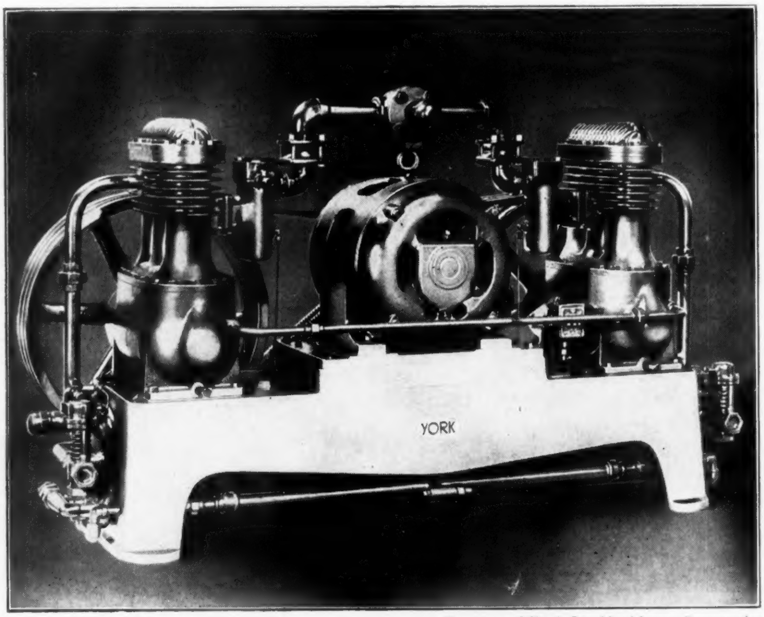
In the central station type of installation pressure lubrication is especially adapted to cylinder and rod lubrication via the oil lantern, or oil recess within the piston rod stuffing box. By properly constructing a stuffing box with a lead to come from the lubricator, it is possible to operate the piston rod continually through a ring of oil. In this way effective rod lubrication, as well as sealing against pressure, can be maintained.

To lubricate the cylinder in addition, it is only necessary to deliver additional oil to the stuffing box lantern and provide a so-called overflow pipe to carry this to the refrigerant suction line adjacent to the cylinder. In effect, this is similar to the principles of steam cylinder lubrication, the refrigerating gas being impregnated with vaporized lubricant prior to its passage through the compressor.

Mechanical force feed lubricators can also be used where compressor cylinders are to be pressure oiled. Excellent economy will be attained by regulating such lubricators so that just enough oil is delivered to maintain the requisite lubricating films, with the least amount of excess to drain off.

Enclosed Oil Pump Design

In realization of the necessity for controlled lubrication, certain compressor builders have given some noteworthy study to the application of the enclosed type of force-feed oil pump. One particular design has provision for location of this pump in the base of the crankcase, driving through sprockets by chain connection to the main shaft. By locating the pump also at the lowest part of the case the possibility of loss of suction is eliminated inasmuch as the oil is continually being returned by gravity. This assures positive delivery of oil to all reciprocating parts through the pipe connections provided for same.



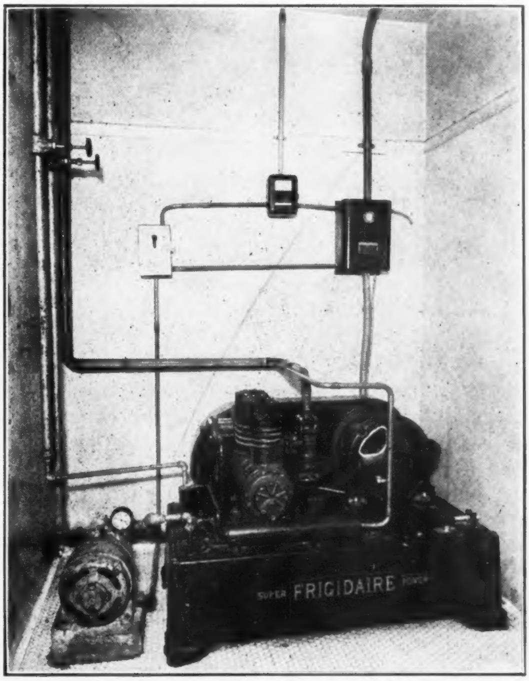
Courtesy of York Ice Machinery Corporation

Fig. 17—A York duplex triple Freon condensing unit. This installation is provided with a "Centriforce Oiler" which delivers a constant stream of oil to the thrust bearing. The main bearings are submerged in oil and a splash system is provided for the wrist pin bearings and cylinder walls.

RING-OILED BEARINGS

Lubrication by means of the ring oiler is applicable to the outboard bearings of the crankshaft in certain types of heavy duty reciprocating machines and to the rotor bearings of the centrifugal compressor. In connection with the latter the oil performs a dual function in that it not only lubricates the bearings but also maintains an automatic oil seal against loss of vacuum. This seal at the

drive end of the centrifugal compressor is obtained through an automatic mechanism actuated by the oil pressure developed during operation, and by springs when the machine is at rest. The principle of operation, according to Carrier Engineering Corporation—"comprises a rotating and a stationary disc, held in position by the oil pressure and separated from actual wearing contact by a film of oil under pressure. When the machine is stopped and the oil pressure ceases compression springs are automatically released and these then effect an equally dependable and leak-proof seal while the machine is inoperative."



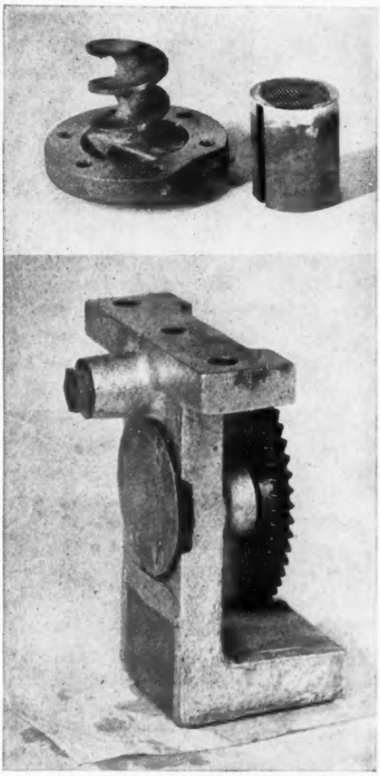
Courtesy of Frigidaire Corporation

Fig. 18—A Frigidaire hotel installation showing manner of arrangement of piping and controls.

As a means of lubrication the ring oiler is simple, clean, entirely automatic, uniform in oil distribution and requiring of but little attention. In construction it comprises a bearing housing which is built with a reservoir and a slot of sufficient width and depth in which revolve one or more rings suspended from the shaft, according to the length of the bearing; the turning of the shaft causes the rings to rotate. By this action a certain amount of oil is carried to the top of the shaft from whence it flows into the bearing oil grooves and clearance space to be ultimately distributed over the entire wearing surface. The oil after passing through the bearing flows out to the end or ends of the shaft and back to the reservoir to a return chamber which is part of the bearing housing.

A ring-oiled bearing is flood-lubricated with a considerable excess of oil over the amount necessary to furnish the requisite oil film. Bearings designed for this type of lubrication may be said to be doubly protected in that the oil serves not only as a lubricant, but also as a cooling medium to carry away part of the frictional heat developed, thereby reducing the temperature of operation. If the oil reservoir in the base of the bearing has been properly designed and is of sufficient capacity, this overheated oil in turn becomes sufficiently cooled after each circulation to enable it to perform this heat transfer function indefinitely.

Oil splash or churning is objectionable in the centrifugal compressor due to the possibility of impairment of the seal. For this reason oil which is carried to the top of the bearing on this machine must be returned to the reservoir as rapidly as it is delivered by the ring in order to avoid undue accumulation in the upper part of the housing. The same condition might arise if the oil is carried too high in the well, or if the ring is too small or rotates too rapidly.



Courtesy of Westinghouse Electric and Manufacturing Company

Fig. 19—Showing a Westinghouse oil separator and oil pump. The former extracts oil from the refrigerant by centrifugal and baffle action. A strainer is also built in to prevent possibility of entry of foreign matter. The oil pump is of the automotive type, as indicated.

PISTON RING INSTALLATION

The use of piston rings in the reciprocating type of air-conditioning compressor will be dependent upon the size and design of the machine. Rings are always used in the horizontal compressor; in the smaller unit type of vertical machines, however, piston rings may be eliminated in favor of closer clearance or a tighter fit between the pistons and cylinders. This practice, on the other hand, requires very accurate machine work and thorough knowledge of materials and their susceptibility to wear.

In the interest of maintenance of a suitable seal, and preventing abnormal passage of lubricating oil from the crankcase into the refrigerating side of the system, some very interesting studies have been made in regard to ring design, materials and installation. It has been indicated that the conventional type of soft iron ring is not always dependable due to the tendency it may have to warp or bend, especially when being installed. Any deformation may, of course, lead to binding or even sticking in the ring grooves. Obviously this may result in faulty lubrication, an imperfect seal, and passage of a considerable volume of oil over into the refrigerating or heat transfer side of the system to cause reduced efficiency of the entire unit.

MOTOR AND FAN BEARING LUBRICATION

Electric motor bearings and the bearings of other accessories such as fans, which are essential to a mechanical air conditioning system, are largely of the anti-friction type. In addition, the ball bearing hanger has been widely adopted in connection with railroad car air circulating systems. Lubrication of such bearings should differ but little from the lubrication of the industrial ball or roller bearing motor, with the exception that location in confined spaces might, in some cases, tend to cause higher average bearing temperatures in operation.

The first cost of such bearings may be somewhat higher than the conventional plain bearing. Positive protection to justify this cost is, therefore, essential. Such protection is assured by lubrication provided the proper lubricant is used. Normally, the design will call for a grease, the bearing seals being so designed as to enable such a lubricant to function at its best, apart from contamination from external sources. This will assure easy rolling of the bearing elements, with minimum friction and wear. Rolling motion must be maintained as perfectly as possible, however, for if it is impaired in the case of even but one ball or roller, more or less sliding will occur to the detriment of the contact surfaces of itself as well as the raceways.

Adequate sealing is highly important on any air conditioning installation, not only as a protection against contamination, but also in the interest of preventing leakage and necessity for frequent renewal of grease. It is obvious that positive protection of the bearing elements cannot be assured if the lubricant is prematurely lost, furthermore, leakage, especially in a railroad car installation where the fans and motors may be located overhead in a space above the doors, might readily cause considerable expense and discomfort to passengers should this leakage drip through and onto clothing.

While a tightly sealed bearing will, of course, permit the use of a lighter lubricant, which will lead to reduction in torque and power consumption, the matter of temperature must not be overlooked, for temperature will affect the consistency of any grease. Research in grease manufacture has developed a type of lubricant which is possessed of certain highly desirable properties, in that it resists change in consistency and even at higher temperatures it will train with the bearing and not work out. Furthermore, it is remarkably low in torque characteristics. From a chemical angle, it is free from acid forming tendencies which assures protection against corrosion, and is resistant to oxidation or expansion through air entrainment. These properties, along with an ability of the lubricant to resist oil separation, should be most carefully considered in the purchase of grease for any ball or roller bearing.

Application or renewal of lubricant is also important. One should never force an excess of grease into any anti-friction bearing housing by either a compression grease cup or pressure gun. The latter must be handled especially carefully due to the potential pressures available. If pressure is not controlled the charging of too much grease may affect the tightness of the bearing seal. An excess of grease in the bearing may also lead to overheating as well as increase in power consumption. For these reasons, operators and maintenance mechanics should realize that any ball or roller bearing has a certain limited capacity for lubricants which should not be exceeded. Unfortunately there is no direct way of determining this, hence the advisability of removing the bearing caps, and inspecting at overhaul periods. Experience with bearings of various size, and knowledge of the effectiveness of their seals, along with the lubricating ability of certain greases, will soon enable an observant operator to develop a suitable lubrication schedule which will assure bearing protection and economy of lubricant.

Printed in U. S. A. by
Edgar C. Rowe Co., Inc.,
72 Washington St., N. Y. C.